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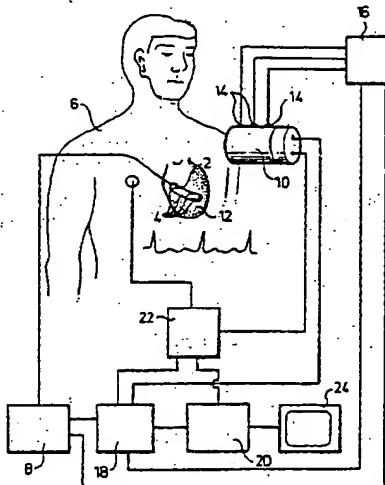
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(54) System for three-dimensional imaging of an internal organ or body structure

(57) A system for 3-dimensional imaging of an internal organ (12) or body structure of a patient (6), comprising an ultrasound probe (10), equipped with localization sensors (14) intended for application to the exterior of the patient in order to generate an ultrasonogram of the organ or body structure. A localization unit (16) is arranged to determine the position of the probe in relation to a reference (2, 4), and an image generation unit (18) is arranged to generate a three-dimensional image of the organ from a plurality of ultrasonograms taken with the probe in different positions and from associated information from the localization unit on the probe's position. At least one moveable reference sensor (4) is devised to be placed in a fixed position in relation to the said organ or body structure to be visualized in order to form the said reference.



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detail of the three-dimensional image obtained.

[0024] Since a detailed three-dimensional image of the heart can be obtained quickly and simply in this way, direct study of e.g. the movements of heart valves, and simple introduction of e.g. catheters for imaging, ablation, pressure measurement etc. become possible, and the catheters can be advanced to the exact position desired with no need to move the reference catheter and no need for fluoroscopic imaging.

[0025] The invention has been described above as primarily applied to the heart, but the system according to the invention can obviously be used for obtaining images of any internal organ or body structure, including e.g. blood vessels, various abdominal organs etc.

### Claims

1. A system for three-dimensional imaging of an internal organ (12) or body structure of patient (6), comprising an ultrasound probe (10) equipped with localization sensors (14), intended for application to the exterior of the patient in order to generate an ultrasonograph of the organ (12) or body structure, a localization unit (16) arranged to determine the position of the probe relative to a reference (2, 4) and an image generating unit (18) arranged to generate a three-dimensional image of the organ from a plurality of ultrasonographs captured with the probe in different positions and from associated information from the localization unit on the position of the probe, characterized in that at least one moveable reference sensor (4) is devised to be placed in a fixed position in relation to the said organ (12) or body structure to be visualized so as to form the said reference.
2. The system according to claim 1, characterized in that the reference sensor (4) is mounted on a reference catheter (2) intended for insertion to a fixed position in the organ (12) or body structure to be visualized.
3. The system according to claim 1 or 2, characterized in that the probe (10) is equipped with at least three separate localization sensors (14).
4. The system according to any of claims 1-3, characterized in that the localization sensors (14) are arranged on the probe (10) in an essentially straight line that, when the probe is applied to the patient (6), is mainly perpendicular to the probe's contact surface with the patient.
5. The system according to claim 4, characterized in that four separate reference sensors (14) are arranged on the reference catheter (2).
6. The system according to any of the preceding

claims, characterized in that each reference and localization sensor (4, 14) has an ultrasound transceiver, and the localization unit (16) is arranged to determine the position of the probe (10), in relation to the reference sensor(s), from signals from the reference and localization sensors.

7. The system according to any of the previous claims, characterized in that the localization unit (16) is also arranged to determine the aiming direction and rotational position of the probe (10), in addition to its position, from signals from the reference and localization sensors (4, 14).
8. The system according to any of the previous claims, characterized in that image storage means (20) are arranged for storing the three-dimensional image of the organ (12).
9. The system according to claim 8, characterized in that an ECG device (22) is arranged to trigger the image generating unit (18) and the said image storage means (20) for storing images from ultrasonographs taken at a specific point in the heart cycle.

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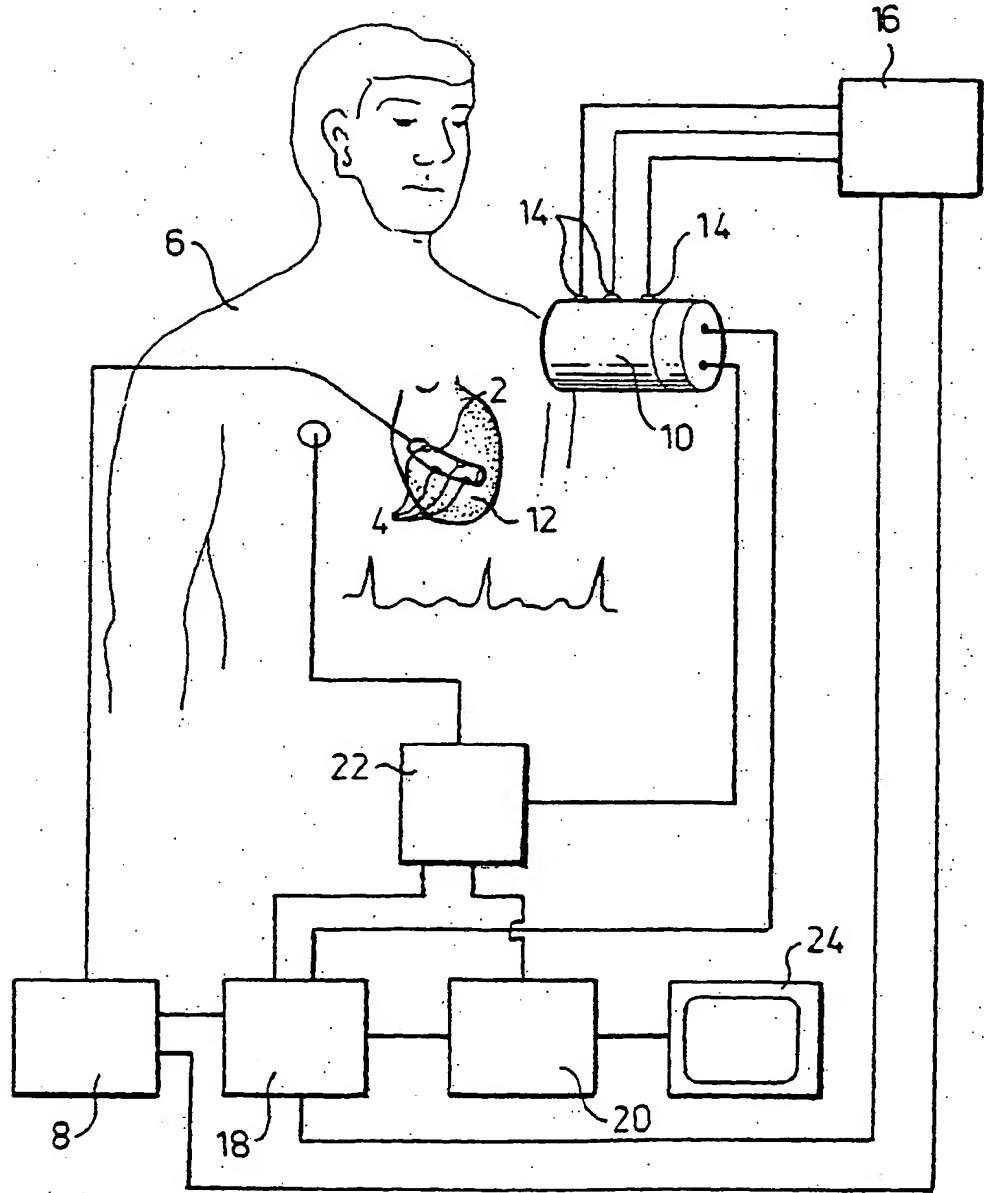
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## EUROPEAN SEARCH REPORT

Application Number  
EP 99 11 9034

DOCUMENTS CONSIDERED TO BE RELEVANT			CLASSIFICATION OF THE APPLICATION (Int.Cl.7)										
Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim											
X	WO 97 29709 A (D.E. ACKER ET AL.) 21 August 1997 (1997-08-21) * page 19, line 3 - page 22, line 12 *	1-3,6,7	A61B8/12 A61B8/08										
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<p>The present search report has been drawn up for all claims</p> <table border="1" style="width: 100%; border-collapse: collapse;"> <tr> <td style="width: 33%;">Place of search.</td> <td style="width: 33%;">Date of completion of the search</td> <td style="width: 33%;">Examiner</td> </tr> <tr> <td>THE HAGUE</td> <td>8 March 2000</td> <td>Rieb, K.D.</td> </tr> </table>				Place of search.	Date of completion of the search	Examiner	THE HAGUE	8 March 2000	Rieb, K.D.				
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<p>CATEGORY OF CITED DOCUMENTS</p> <table border="0" style="width: 100%; border-collapse: collapse;"> <tr> <td style="width: 33%;">X : particularly relevant if taken alone</td> <td style="width: 33%;">T : theory or principle underlying the invention</td> </tr> <tr> <td>Y : particularly relevant if combined with another document of the same category</td> <td>E : earlier patent document, but published on or after the filing date</td> </tr> <tr> <td>A : technological background</td> <td>D : document cited in the application.</td> </tr> <tr> <td>O : non-written disclosure</td> <td>L : document cited for other reasons</td> </tr> <tr> <td>P : intermediate document</td> <td>&amp; : member of the same patent family, corresponding document</td> </tr> </table>				X : particularly relevant if taken alone	T : theory or principle underlying the invention	Y : particularly relevant if combined with another document of the same category	E : earlier patent document, but published on or after the filing date	A : technological background	D : document cited in the application.	O : non-written disclosure	L : document cited for other reasons	P : intermediate document	& : member of the same patent family, corresponding document
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